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91-216-E

June 11, 2004

S. C. PUBLIC SERVICE COMMISSION
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HAND DELIVERY
The Honorable Bruce F. Duke
Executive Director
Public Service Commission of South Carolina
101 Executive Center Drive
Columbia, South Carolina 29211

***Re*: 2004 Nuclear Decommissioning Cost Update**

Dear Mr. Duke:

Pursuant to Public Service Commission of South Carolina ("Commission") Order No. 94-1308 dated December 30, 1994 in Docket No. 91-216-E, we write to notify the Commission of the results of the 2004 nuclear decommissioning cost studies performed by Duke Power, a division of Duke Energy Corporation ("Duke Power").

We hereby file one (1) copy of the complete decommissioning study and we also provide herewith, one (1) additional complete copy of the decommissioning study. Due to the voluminous length of the decommissioning study, we also provide three sets of twenty-five (25) copies each, of the executive summaries of the decommissioning study for the Oconee, McGuire and Catawba plants, respectively.

A brief summary of the findings and any significant changes in cost estimates follows. Duke Power retained TLG Services, Inc. ("TLG") to conduct site-specific decommissioning studies of Duke Power's seven nuclear units, and Duke Power approved the studies on March 15, 2004. TLG determined a total cost of $2,321 million to decommission the facilities. The decommissioning costs by plant are as follows: Oconee - $1,185 million; McGuire - $1,011 million; and Catawba - $125 million. The $125 million for Catawba represents Duke's 12.5 percent ownership of the station. The previous site-specific studies performed by TLG in 1999

determined a total cost to decommission of $1,913 million ($2,153 million in 2003 dollars at 3% inflation).

The changes in the current decommissioning cost estimates from the 1999 studies are primarily due to inflation and cost increases in the area of program management. Program management costs increased by $260 million due to inflation and an increase in the size of the organization designated to manage the decommissioning project. The increase in the size of the organization was based on current industry field experience at other facilities undergoing decommissioning.

By letter dated April 20, 2004, Duke Power informed this Commission that it has recently changed its method of funding non-radiological decommissioning accounts. A description of this change follows. By order issued February 5, 2004, in Docket No. E-100, Sub 56, the North Carolina Utilities Commission ("NCUC") directed Duke Power and Progress
Energy Carolinas, Inc. to begin the transition of their internal non-radiological nuclear decommissioning fund to external accounts. Duke Power decided to transfer the total balance of its internal reserve funds into an external trust account before the NCUC ordered deadline.

Duke Power amended its existing master trust agreement with Mellon Bank, the trustee of its radiological decommissioning accounts, to permit the establishment of a non-qualified account under the agreement to hold non-radiological funds externally. These non-radiological funds were transferred to Mellon Bank on April 29, 2004. The trust agreement amendments permit such funds, while segregated from radiological decommissioning accounts, to be managed collectively with such other funds. Additionally, the amendments allow Duke Power to use any funds in the new account for radiological decommissioning.

The Honorable Bruce F. Duke
Executive Director
Public Service Commission of South Carolina
101 Executive Center Drive
Columbia, South Carolina, 29211

We trust that this information is sufficient to update the Commission on Duke Power's nuclear decommissioning costs. Please let us know if you have any questions.

Respectfully submitted,

Lawrence B. Somers
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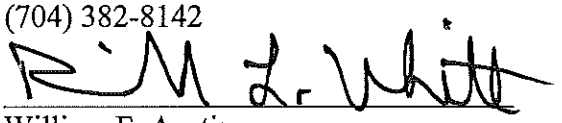
Duke Power, a division of Duke Energy Corporation
P.O. Box 1244 (PB05E)_
Charlotte, North Carolina 28201-1244
(704) 382-8142



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EXECUTIVE SUMMARY

This report presents estimates of the cost to decommission the Oconee Nuclear Station (Oconee) following the scheduled cessation of plant operations. The analysis relies upon site-specific technical information, originally developed in an evaluation prepared in 1994,[1] revised in 1999,[2] and updated to reflect current plant conditions, operating assumptions, and relevant industry experience in undertaking such projects. The updated estimates are designed to provide Duke Energy Corporation (Duke Energy) with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The primary goal of the decommissioning is the removal and disposal of the contaminated systems and structures so that the plant's operating licenses can be terminated. The analysis recognizes that spent fuel may be stored at the site in the plant's storage pools and/or in an independent spent fuel storage installation (ISFSI) until such time that it can transferred to a U.S. Department of Energy (DOE) facility. The cost for the continued operation of the fuel buildings for interim wet fuel storage is included for a period of approximately 13 years following the cessation of Unit 1/2 operations in 2033 before the transfer is ultimately completed in 2046. The ISFSI is expected to operate concurrently through the year 2045 until it is also emptied. The estimates also include those costs to manage and subsequently decommission these facilities.

The estimates are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. They also include the dismantling of non-essential structures and limited restoration of the site. A complete discussion of the strategic assumptions is presented in Section 3.

Alternatives and Regulations

The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule adopted on June 27, 1988.[3] In this rule, the NRC set forth financial criteria for decommissioning licensed nuclear power

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1 "Decommissioning Cost Study for the Oconee Nuclear Station," Document No. D03-25-009, TLG Services, Inc., December 1994.

2 "Decommissioning Cost Update for the Oconee Nuclear Station," Document No. D03-1331-004, TLG Services, Inc., November 1999.

3 U.S. Code of Federal Regulations, Title 10, Parts 30, 40, 50, 51, 70 and 72 "General Requirements for Decommissioning Nuclear Facilities," Nuclear Regulatory Commission, Federal Register Volume 53, Number 123 (p 24018 et seq.), June 27, 1988.

facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[4]
>
> SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."[5] Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.
>
> ENTOMB is defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property."[6] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years.

The 60-year restriction has limited the practicality of the ENTOMB alternative at commercial reactors that generate significant amounts of long-lived radioactive material. In 1997, the Commission directed its staff to re-evaluate this alternative and identify the technical requirements and regulatory actions that would be necessary for entombment to become a viable option. The resulting evaluation provided several recommendations; however, rulemaking has been deferred pending the completion of additional research studies, e.g., on engineered barriers.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the

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4 Ibid. Page FR24022, Column 3.
5 Ibid.
6 Ibid. Page FR24023, Column 2.

decommissioning process.[7] The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184, issued in July 2000, further described the methods and procedures acceptable to the NRC staff for implementing the requirements of the 1996 revised rule relating to the initial activities and major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and processes described in the amended regulations.

Methodology

The methodology used to develop the estimate described within this document follows the basic approach originally presented in the cost estimating guidelines[8] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

An activity duration critical path is used to determine the total decommissioning program schedule. The schedule is relied upon in calculating the carrying costs, which include program management, administration, field engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting cost estimate.

Contingency

Consistent with cost estimating practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."[9] The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in

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7 U.S. Code of Federal Regulations, Title 10, Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, Federal Register Volume 61, (p 39278 et seq.), July 29, 1996.

8 T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.

9 Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239.

this estimate, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

The use and role of contingency within decommissioning estimates is not a safety factor issue. Safety factors provide additional security and address situations that may never occur. Contingency funds, by contrast, are expected to be fully expended throughout the program. Inclusion of contingency is necessary to provide assurance that sufficient funding will be available to accomplish the intended tasks.

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[10] and its Amendments of 1985,[11] the states became ultimately responsible for the disposition of radioactive waste generated within their own borders.

South Carolina is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina formally joined the Northeast Regional Compact. The Barnwell Low-Level Radioactive Waste Management Facility, located in South Carolina, is expected to be available to support the decommissioning of Oconee. It is also assumed that Duke Energy can access other disposal sites should it prove cost-effective. As such, rate schedules for both the Barnwell and the Envirocare facility in Utah are used to generate disposal costs.

High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"[12] (NWPA) in 1982, assigning the responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. Two permanent disposal facilities were envisioned, as well as an interim storage facility. To recover the cost, the legislation created a Nuclear Waste Fund through which money is collected from the sale of electricity generated by the power plants. NWPA, along with the individual disposal contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

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10 "Low-Level Radioactive Waste Policy Act," Public Law 96-573, 1980.

11 "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1986.

12 "Nuclear Waste Policy Act of 1982 and Amendments," U.S. Department of Energy's Office of Civilian Radioactive Management, 1982.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to initiate the disposal of spent nuclear fuel and high level waste, as required by the NWPA and the utility contracts. When the DOE attempted to absolve itself of any responsibility and the adverse impacts on utilities resulting from its failure to meet this date, utilities sought relief in the federal courts. In a series of rulings, the courts upheld that the DOE had an unconditional obligation to begin accepting spent fuel in 1998. The courts also ruled that the DOE cannot argue that the delays in fulfilling this obligation were unavoidable.

Despite these facts, the DOE continues to link initial acceptance of commercial spent fuel to the schedule for a geologic repository, which it currently projects to begin operating no earlier than 2010. The DOE has also failed to communicate to utilities a revised schedule for acceptance of spent fuel. Thus, spent fuel logistics supporting this analysis are based on available information and projections related to the DOE's initial performance, acceptance rates, and use of spent fuel acceptance allocations assigned to Duke Energy.

Operation of DOE's yet-to-be constructed repository is contingent upon the review and approval of the facility's license application by the NRC, the successful resolution of pending litigation, and the development of a national transportation system. By comparison, the Private Fuel Storage consortium submitted an application for an interim storage facility in 1997. To date, the Atomic Safety and Licensing Board has issued only a partial ruling on one of several issues that need to be resolved prior to the NRC issuing a license for the facility. With a more technically complex and politically sensitive application for permanent disposal, it is not unreasonable to expect that the NRC's approval to construct the repository at Yucca Mountain will require at least as long a review period. Construction would therefore begin sometime around the year 2010, at the earliest. The agency has no plans for receiving spent fuel from commercial nuclear plant sites prior to this date and startup operations may be phased in, creating additional delays. For estimating purposes, Duke Energy has assumed that the high-level waste repository, or some interim storage facility, will be fully operational by 2015. This timetable is consistent with the findings of an evaluation recently issued to Congress by the Government Accounting Office.[13] Under this scenario, acceptance of fuel from Oconee would not begin until 2016.

The NRC requires that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is

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13 "Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project," GAO-02-191, December 2001.

transferred to the DOE.[14] Interim storage of the fuel, until the transfer is complete, will be in the storage pools and/or an ISFSI located on the Oconee site.

The ISFSI, which is independently licensed and operated, will be operational prior to the cessation of plant operations. The DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority. Given this scenario and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 13 years after the cessation of Unit 1/2 operations in 2033 or 12 years after Unit 3 shuts down in 2034. As such, costs are included within the estimates for ISFSI operations through the year 2045 and pool operations through the year 2046.

Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition once the license is terminated is clearly the most appropriate and cost-effective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized is more efficient and less costly than if the process were deferred. Experience at shutdown generating stations has shown that plant facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and the demolition work force. Consequently, this study assumes that non-essential site structures within the restricted access area are removed to a nominal depth of three feet below the local grade level wherever possible. The site is then graded and stabilized.

Summary

The costs to decommission Oconee are evaluated for both the DECON and SAFSTOR alternatives. Regardless of the timing of the activities, the estimates assume the eventual removal of all the contaminated and activated plant components and structural materials, such that the facility operator may then have unrestricted use of the site with no further requirement for an operating license. Delayed decommissioning is initiated after the spent fuel has been removed from the site and is accomplished within the 60-year period required by current NRC regulations. In the interim, the spent fuel remains in storage at the site until the transfer to a DOE facility can be completed. Once the transfer is complete, the storage facilities are also decommissioned.

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14 "Domestic Licensing of Production and Utilization Facilities," U.S. Code of Federal Regulations, Title 10, Part 50.54 (bb).

The scenarios analyzed for the purpose of generating the estimates are described in Section 2. The assumptions are presented in Section 3, along with schedules of annual expenditures. The major cost contributors are identified in Section 6, with detailed activity costs, waste volumes, and associated manpower requirements delineated in Appendices C and D. Cost summaries are provided at the end of this section for the major cost components.

COST SUMMARY
DECON ALTERNATIVE
(thousands of 2003 dollars)

Activity	Unit 1	Unit 2	Unit 3	Total
Decontamination	7,739	9,545	13,881	31,165
Removal	55,613	57,424	98,013	211,050
Packaging	9,054	9,241	9,773	28,067
Transportation	3,357	3,477	3,807	10,642
Waste Disposal	67,656	73,472	83,096	224,224
Off-site Waste Processing	16,695	17,317	28,486	62,498
Program Management [1]	134,204	120,043	187,075	441,322
Spent Fuel Pool Isolation	4,666	4,666	6,221	15,554
ISFSI Related	7,781	7,328	17,373	32,482
Insurance and Regulatory Fees	13,912	13,172	11,898	38,982
Energy	5,244	5,046	5,482	15,772
Characterization and Licensing Surveys	7,849	7,645	9,438	24,932
Property Taxes	10,997	9,176	9,489	29,661
Miscellaneous Equipment	5,689	5,648	5,669	17,007
Miscellaneous Site Services	41	41	1,603	1,686
Total [2]	350,496	343,241	491,305	1,185,043
NRC License Termination	312,495	306,149	406,355	1,024,999
Spent Fuel Management	13,914	13,461	35,927	63,302
Site Restoration	24,087	23,631	49,023	96,741

[1] Utility staffing includes engineering and security.
[2] Columns may not add due to rounding.

COST SUMMARY
SAFSTOR ALTERNATIVE
(thousands of 2003 dollars)

Activity	Unit 1	Unit 2	Unit 3	Total
Decontamination	7,831	9,435	14,499	31,765
Removal	54,678	57,306	95,925	207,909
Packaging	4,796	4,959	5,500	15,256
Transportation	2,559	2,652	2,985	8,196
Waste Disposal	45,364	48,624	55,333	149,321
Off-site Waste Processing	19,190	20,150	32,602	71,942
Program Management [1]	242,581	181,988	211,516	636,085
Spent Fuel Pool Isolation	4,666	4,666	6,221	15,554
ISFSI Related	7,781	7,328	17,373	32,482
Insurance and Regulatory Fees	40,676	40,226	39,033	119,935
Energy	14,003	13,687	16,142	43,833
Characterization and Licensing Surveys	9,237	9,032	10,825	29,094
Property Taxes	10,694	9,386	9,769	29,849
Miscellaneous Equipment and Bldg. Maint.	14,483	14,497	16,484	45,463
Miscellaneous Site Services	41	41	1,603	1,686
Total [2]	478,580	423,977	535,812	1,438,369
NRC License Termination	393,479	353,725	405,703	1,152,907
Spent Fuel Management	55,134	40,636	69,943	165,713
Site Restoration	29,966	29,617	60,167	119,750

[1] Utility staffing includes engineering and security.
[2] Columns may not add due to rounding.

EXECUTIVE SUMMARY

This report presents estimates of the cost to decommission the McGuire Nuclear Station (McGuire) following the scheduled cessation of plant operations. The analysis relies upon site-specific technical information, originally developed in an evaluation prepared in 1994,[1] revised in 1999,[2] and updated to reflect current plant conditions, operating assumptions, and relevant industry experience in undertaking such projects. The updated estimates are designed to provide Duke Energy Corporation (Duke Energy) with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The primary goal of the decommissioning is the removal and disposal of the contaminated systems and structures so that the plant's operating licenses can be terminated. The analysis recognizes that spent fuel may be stored at the site in the plant's storage pools and/or in an independent spent fuel storage installation (ISFSI) until such time that it can transferred to a U.S. Department of Energy (DOE) facility. The cost for the continued operation of the fuel buildings for interim wet fuel storage is included for a period of approximately nine years following the cessation of operations in 2043. The ISFSI is expected to operate through the year 2059 before the transfer is ultimately complete. The estimates also include those costs to manage and subsequently decommission this facility.

The estimates are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. They also include the dismantling of non-essential structures and limited restoration of the site. A complete discussion of the strategic assumptions is presented in Section 3.

Alternatives and Regulations

The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule adopted on June 27, 1988.[3] In this rule, the NRC set forth financial criteria for decommissioning licensed nuclear power

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1 "Decommissioning Cost Study for the McGuire Nuclear Station," Document No. D03-25-007, TLG Services, Inc., December 1994.

2 "Decommissioning Cost Update for the McGuire Nuclear Station," Document No. D03-1331-003, TLG Services, Inc., November 1999.

3 U.S. Code of Federal Regulations, Title 10, Parts 30, 40, 50, 51, 70 and 72 "General Requirements for Decommissioning Nuclear Facilities," Nuclear Regulatory Commission, Federal Register Volume 53, Number 123 (p 24018 et seq.), June 27, 1988.

facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[4]
>
> SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."[5] Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.
>
> ENTOMB is defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property."[6] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years.

The 60-year restriction has limited the practicality of the ENTOMB alternative at commercial reactors that generate significant amounts of long-lived radioactive material. In 1997, the Commission directed its staff to re-evaluate this alternative and identify the technical requirements and regulatory actions that would be necessary for entombment to become a viable option. The resulting evaluation provided several recommendations; however, rulemaking has been deferred pending the completion of additional research studies, e.g., on engineered barriers.

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decommissioning process.[7] The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184, issued in July 2000, further described the methods and procedures acceptable to the NRC staff for implementing the requirements of the 1996 revised rule relating to the initial activities and major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and processes described in the amended regulations.

Methodology

The methodology used to develop the estimate described within this document follows the basic approach originally presented in the cost estimating guidelines[8] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

An activity duration critical path is used to determine the total decommissioning program schedule. The schedule is relied upon in calculating the carrying costs, which include program management, administration, field engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting cost estimate.

Contingency

Consistent with cost estimating practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."[9] The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in

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7 U.S. Code of Federal Regulations, Title 10, Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, Federal Register Volume 61, (p 39278 et seq.), July 29, 1996.

8 T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.

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with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to initiate the disposal of spent nuclear fuel and high level waste, as required by the NWPA and the utility contracts. When the DOE attempted to absolve itself of any responsibility and the adverse impacts on utilities resulting from its failure to meet this date, utilities sought relief in the federal courts. In a series of rulings, the courts upheld that the DOE had an unconditional obligation to begin accepting spent fuel in 1998. The courts also ruled that the DOE cannot argue that the delays in fulfilling this obligation were unavoidable.

Despite these facts, the DOE continues to link initial acceptance of commercial spent fuel to the schedule for a geologic repository, which it currently projects to begin operating no earlier than 2010. The DOE has also failed to communicate to utilities a revised schedule for acceptance of spent fuel. Thus, spent fuel logistics supporting this analysis are based on available information and projections related to the DOE's initial performance, acceptance rates, and use of spent fuel acceptance allocations assigned to Duke Energy.

Operation of DOE's yet-to-be constructed repository is contingent upon the review and approval of the facility's license application by the NRC, the successful resolution of pending litigation, and the development of a national transportation system. By comparison, the Private Fuel Storage consortium submitted an application for an interim storage facility in 1997. To date, the Atomic Safety and Licensing Board has issued only a partial ruling on one of several issues that need to be resolved prior to the NRC issuing a license for the facility. With a more technically complex and politically sensitive application for permanent disposal, it is not unreasonable to expect that the NRC's approval to construct the repository at Yucca Mountain will require at least as long a review period. Construction would therefore begin sometime around the year 2010, at the earliest. The agency has no plans for receiving spent fuel from commercial nuclear plant sites prior to this date and startup operations may be phased in, creating additional delays. For estimating purposes, Duke Energy has assumed that the high-level waste repository, or some interim storage facility, will be fully operational by 2015. This timetable is consistent with the findings of an evaluation recently issued to Congress by the Government Accounting Office.[13] Under this scenario, acceptance of fuel from McGuire would not begin until 2018.

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13 "Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project," GAO-02-191, December 2001.

The NRC requires that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE.[14] Interim storage of the fuel, until the transfer is complete, will be in the storage pools and/or an ISFSI located on the McGuire site.

The ISFSI, which is independently licensed and operated, will be operational prior to the cessation of plant operations. The DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority. Given this scenario and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 15 years after the cessation of plant operations in 2043. As such, costs are included within the estimates for ISFSI operations through the year 2059.

Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition once the license is terminated is clearly the most appropriate and cost-effective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized is more efficient and less costly than if the process were deferred. Experience at shutdown generating stations has shown that plant facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and the demolition work force. Consequently, this study assumes that non-essential site structures within the restricted access area are removed to a nominal depth of three feet below the local grade level wherever possible. The site is then graded and stabilized.

Summary

The costs to decommission McGuire are evaluated for both the DECON and SAFSTOR alternatives. Regardless of the timing of the activities, the estimates assume the eventual removal of all the contaminated and activated plant components and structural materials, such that the facility operator may then have unrestricted use of the site with no further requirement for an operating license. Delayed decommissioning is initiated after the spent fuel has been removed from the site and is accomplished within the 60-year period required by current NRC regulations. In the interim, the spent fuel remains in storage at the site until the transfer to a DOE

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14 "Domestic Licensing of Production and Utilization Facilities," U.S. Code of Federal Regulations, Title 10, Part 50.54 (bb).

facility can be completed. Once the transfer is complete, the storage facilities are also decommissioned.

The scenarios analyzed for the purpose of generating the estimates are described in Section 2. The assumptions are presented in Section 3, along with schedules of annual expenditures. The major cost contributors are identified in Section 6, with detailed activity costs, waste volumes, and associated manpower requirements delineated in Appendices C and D. Cost summaries are provided at the end of this section for the major cost components.

COST SUMMARY
SAFSTOR ALTERNATIVE
(thousands of 2003 dollars)

Activity	Unit 1	Unit 2	Total
Decontamination	10,912	11,004	21,916
Removal	71,472	97,060	168,531
Packaging	9,391	9,439	18,830
Transportation	3,165	3,314	6,479
Waste Disposal	65,324	66,761	132,085
Off-site Waste Processing	27,013	29,745	56,758
Program Management [1]	262,243	215,698	477,941
Spent Fuel Pool Isolation	9,332	6,221	15,554
ISFSI Related	16,582	17,746	34,328
Insurance and Regulatory Fees	48,407	45,765	94,172
Energy	18,640	17,351	35,991
Characterization and Licensing Surveys	11,660	12,684	24,344
Property Taxes	11,798	12,476	24,274
Miscellaneous Equipment and Bldg. Maintenance	15,622	16,860	32,482
Miscellaneous Site Services	5	1,912	1,917
Total [2]	581,566	564,036	1,145,602
NRC License Termination	467,587	439,261	906,848
Spent Fuel Management	82,483	68,870	151,353
Site Restoration	31,497	55,904	87,401

[1] Utility staffing includes engineering and security.
[2] Columns may not add due to rounding.

EXECUTIVE SUMMARY

This report presents estimates of the cost to decommission the Catawba Nuclear Station (Catawba) following the scheduled cessation of plant operations. The analysis relies upon site-specific technical information, originally developed in an evaluation prepared in 1994,[1] revised in 1999,[2] and updated to reflect current plant conditions, operating assumptions, and relevant industry experience in undertaking such projects. The updated estimates are designed to provide Duke Energy Corporation (Duke Energy) with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The primary goal of the decommissioning is the removal and disposal of the contaminated systems and structures so that the plant's operating licenses can be terminated. The analysis recognizes that spent fuel may be stored at the site in the plant's storage pools and/or in an independent spent fuel storage installation (ISFSI) until such time that it can transferred to a U.S. Department of Energy (DOE) facility. The cost for the continued operation of the fuel buildings for interim wet fuel storage is included for a period of approximately eight years following the cessation of operations in 2043. The ISFSI is expected to operate through the year 2058 before the transfer is ultimately complete. The estimates also include those costs to manage and subsequently decommission this facility.

The estimates are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. They also include the dismantling of non-essential structures and limited restoration of the site. A complete discussion of the strategic assumptions is presented in Section 3.

Alternatives and Regulations

The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule adopted on June 27, 1988.[3] In this rule, the NRC set forth financial criteria for decommissioning licensed nuclear power

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1 "Decommissioning Cost Study for the Catawba Nuclear Station," Document No. D03-25-008, TLG Services, Inc., December 1994.

2 "Decommissioning Cost Update for the Catawba Nuclear Station," Document No. D03-1331-002, TLG Services, Inc., November 1999.

3 U.S. Code of Federal Regulations, Title 10, Parts 30, 40, 50, 51, 70 and 72 "General Requirements for Decommissioning Nuclear Facilities," Nuclear Regulatory Commission, Federal Register Volume 53, Number 123 (p 24018 et seq.), June 27, 1988.

facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[4]
>
> SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."[5] Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.
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> ENTOMB is defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property."[6] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years.

The 60-year restriction has limited the practicality of the ENTOMB alternative at commercial reactors that generate significant amounts of long-lived radioactive material. In 1997, the Commission directed its staff to re-evaluate this alternative and identify the technical requirements and regulatory actions that would be necessary for entombment to become a viable option. The resulting evaluation provided several recommendations; however, rulemaking has been deferred pending the completion of additional research studies, e.g., on engineered barriers.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the

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4 Ibid. Page FR24022, Column 3.
5 Ibid.
6 Ibid. Page FR24023, Column 2.

decommissioning process.[7] The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184, issued in July 2000, further described the methods and procedures acceptable to the NRC staff for implementing the requirements of the 1996 revised rule relating to the initial activities and major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and processes described in the amended regulations.

Methodology

The methodology used to develop the estimate described within this document follows the basic approach originally presented in the cost estimating guidelines[8] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

An activity duration critical path is used to determine the total decommissioning program schedule. The schedule is relied upon in calculating the carrying costs, which include program management, administration, field engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting cost estimate.

Contingency

Consistent with cost estimating practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."[9] The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in

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7 U.S. Code of Federal Regulations, Title 10, Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, Federal Register Volume 61, (p 39278 et seq.), July 29, 1996.

8 T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.

9 Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239.

this estimate, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

The use and role of contingency within decommissioning estimates is not a safety factor issue. Safety factors provide additional security and address situations that may never occur. Contingency funds, by contrast, are expected to be fully expended throughout the program. Inclusion of contingency is necessary to provide assurance that sufficient funding will be available to accomplish the intended tasks.

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[10] and its Amendments of 1985,[11] the states became ultimately responsible for the disposition of radioactive waste generated within their own borders.

South Carolina is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina formally joined the Northeast Regional Compact. The Barnwell Low-Level Radioactive Waste Management Facility, located in South Carolina, is expected to be available to support the decommissioning of Catawba. It is also assumed that Duke Energy can access other disposal sites should it prove cost-effective. As such, rate schedules for both the Barnwell and the Envirocare facility in Utah are used to generate disposal costs.

High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"[12] (NWPA) in 1982, assigning the responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. Two permanent disposal facilities were envisioned, as well as an interim storage facility. To recover the cost, the legislation created a Nuclear Waste Fund through which money is collected from the sale of electricity generated by the power plants. NWPA, along with the individual disposal contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

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10 "Low-Level Radioactive Waste Policy Act," Public Law 96-573, 1980.

11 "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1986.

12 "Nuclear Waste Policy Act of 1982 and Amendments," U.S. Department of Energy's Office of Civilian Radioactive Management, 1982.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to initiate the disposal of spent nuclear fuel and high level waste, as required by the NWPA and the utility contracts. When the DOE attempted to absolve itself of any responsibility and the adverse impacts on utilities resulting from its failure to meet this date, utilities sought relief in the federal courts. In a series of rulings, the courts upheld that the DOE had an unconditional obligation to begin accepting spent fuel in 1998. The courts also ruled that the DOE cannot argue that the delays in fulfilling this obligation were unavoidable.

Despite these facts, the DOE continues to link initial acceptance of commercial spent fuel to the schedule for a geologic repository, which it currently projects to begin operating no earlier than 2010. The DOE has also failed to communicate to utilities a revised schedule for acceptance of spent fuel. Thus, spent fuel logistics supporting this analysis are based on available information and projections related to the DOE's initial performance, acceptance rates, and use of spent fuel acceptance allocations assigned to Duke Energy.

Operation of DOE's yet-to-be constructed repository is contingent upon the review and approval of the facility's license application by the NRC, the successful resolution of pending litigation, and the development of a national transportation system. By comparison, the Private Fuel Storage consortium submitted an application for an interim storage facility in 1997. To date, the Atomic Safety and Licensing Board has issued only a partial ruling on one of several issues that need to be resolved prior to the NRC issuing a license for the facility. With a more technically complex and politically sensitive application for permanent disposal, it is not unreasonable to expect that the NRC's approval to construct the repository at Yucca Mountain will require at least as long a review period. Construction would therefore begin sometime around the year 2010, at the earliest. The agency has no plans for receiving spent fuel from commercial nuclear plant sites prior to this date and startup operations may be phased in, creating additional delays. For estimating purposes, Duke Energy has assumed that the high-level waste repository, or some interim storage facility, will be fully operational by 2015. This timetable is consistent with the findings of an evaluation recently issued to Congress by the Government Accounting Office.[13] Under this scenario, acceptance of fuel from Catawba would not begin until 2018.

The NRC requires that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is

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13 "Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project," GAO-02-191, December 2001.

transferred to the DOE.[14] Interim storage of the fuel, until the transfer is complete, will be in the storage pools and/or an ISFSI located on the Catawba site.

The ISFSI, which is independently licensed and operated, will be operational prior to the cessation of plant operations. The DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority. Given this scenario and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 14 years after the cessation of plant operations in 2043. As such, costs are included within the estimates for ISFSI operations through the year 2058.

Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition once the license is terminated is clearly the most appropriate and cost-effective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized is more efficient and less costly than if the process were deferred. Experience at shutdown generating stations has shown that plant facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and the demolition work force. Consequently, this study assumes that non-essential site structures within the restricted access area are removed to a nominal depth of three feet below the local grade level wherever possible. The site is then graded and stabilized.

Summary

The costs to decommission Catawba are evaluated for both the DECON and SAFSTOR alternatives. Regardless of the timing of the activities, the estimates assume the eventual removal of all the contaminated and activated plant components and structural materials, such that the facility operator may then have unrestricted use of the site with no further requirement for an operating license. Delayed decommissioning is initiated after the spent fuel has been removed from the site and is accomplished within the 60-year period required by current NRC regulations. In the interim, the spent fuel remains in storage at the site until the transfer to a DOE facility can be completed. Once the transfer is complete, the storage facilities are also decommissioned.

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14 "Domestic Licensing of Production and Utilization Facilities," U.S. Code of Federal Regulations, Title 10, Part 50.54 (bb).

The scenarios analyzed for the purpose of generating the estimates are described in Section 2. The assumptions are presented in Section 3, along with schedules of annual expenditures. The major cost contributors are identified in Section 6, with detailed activity costs, waste volumes, and associated manpower requirements delineated in Appendices C and D. Cost summaries are provided at the end of this section for the major cost components.

COST SUMMARY
DECON ALTERNATIVE
(thousands of 2003 dollars)

Activity	Unit 1	Unit 2	Total
Decontamination	11,756	12,263	24,020
Removal	73,164	98,237	171,401
Packaging	16,186	14,016	30,202
Transportation	3,831	3,305	7,136
Waste Disposal	76,019	72,714	148,733
Off-site Waste Processing	25,442	26,966	52,408
Program Management [1]	146,659	218,515	365,175
Spent Fuel Pool Isolation	9,332	6,221	15,554
ISFSI Related	14,824	20,565	35,389
Insurance and Regulatory Fees	11,585	15,217	26,802
Energy	6,365	7,187	13,552
Characterization and Licensing Surveys	10,647	12,020	22,667
Property Taxes	35,820	36,343	72,163
Miscellaneous Equipment	6,128	6,067	12,195
Miscellaneous Site Services	5	1,912	1,917
Total [2]	447,763	551,549	999,313
NRC License Termination	400,080	461,189	861,269
Spent Fuel Management	19,771	43,305	63,076
Site Restoration	27,912	47,055	74,967

[1] Utility staffing includes engineering and security.
[2] Columns may not add due to rounding.

COST SUMMARY
SAFSTOR ALTERNATIVE
(thousands of 2003 dollars)

Activity	Unit 1	Unit 2	Total
Decontamination	12,665	13,428	26,094
Removal	71,184	94,234	165,419
Packaging	9,563	7,385	16,948
Transportation	3,195	2,665	5,860
Waste Disposal	56,809	52,821	109,629
Off-site Waste Processing	28,007	29,674	57,681
Program Management [1]	251,663	212,221	463,884
Spent Fuel Pool Isolation	9,332	6,221	15,554
ISFSI Related	16,086	17,627	33,713
Insurance and Regulatory Fees	49,044	48,880	97,924
Energy	16,758	16,849	33,607
Characterization and Licensing Surveys	12,034	13,407	25,441
Property Taxes	37,226	37,226	74,452
Miscellaneous Equipment and Bldg. Maintenance	15,370	17,861	33,231
Miscellaneous Site Services	5	1,912	1,917
Total [2]	588,943	572,412	1,161,354
NRC License Termination	473,337	438,153	911,490
Spent Fuel Management	84,141	79,020	163,161
Site Restoration	31,465	55,239	86,704

[1] Utility staffing includes engineering and security.
[2] Columns may not add due to rounding.